PART 1

Current Information on the Health Consequences of Smoking

Summary of the Report

This report is a review of the pertinent medical literature on the health consequences of smoking which has appeared since the publication of the 1968 Supplement to the 1967 Public Health Service Review. The 1964 Report of the Advisory Committee on Smoking and Health, the 1967 Public Health Service Review, and the 1968 Supplement have presented the broad base of converging epidemiological, physiological, pathological, and clinical evidence on which knowledge of the health hazards of smoking is based. Included in this evidence are data which show the magnitude of the excess mortality and morbidity among smokers.

The following conclusions regarding the health consequences of smoking were summarized in the 1968 Supplement:

General Mortality Information

Previous findings reported in 1967 indicate that cigarette smoking is associated with an increase in overall mortality and morbidity and leads to a substantial excess of deaths in those people who smoke. In addition, evidence herein presented shows that life expectancy among young men is reduced by an average of 8 years in "heavy" cigarette smokers, those who smoke over two packs a day, and an average of 4 years in "light" cigarette smokers, those who smoke less than one-half pack per day.

Smoking and Cardiovascular Diseases

Current physiological evidence, in combination with additional epidemiological evidence, confirms previous findings and suggests additional biomechanisms whereby cigarette smoking can contribute to coronary heart disease. Cigarette smoking adversely affects the interaction between the demand of the heart for oxygen and other nutrients and their supply. Some of the harmful cardiovascular effects appear to be reversible after cessation of cigarette smoking.

Because of the increasing convergence of epidemiological and physiological findings relating cigarette smoking to coronary heart disease, it is concluded that cigarette smoking can contribute to the development of cardiovascular disease and particularly to death from coronary heart disease.

Smoking and Chronic Obstructive Bronchopulmonary Diseases

Additional physiological and epidemiological evidence confirms the previous findings that cigarette smoking is the most important cause of chronic non-neoplastic bronchopulmonary disease in the United States.

Cigarette smoking can adversely affect pulmonary function and disturb cardiopulmonary physiology. It is suggested that this can lead to cardiopulmonary disease, notably pulmonary hypertension and cor pulmonale in those individuals who have severe chronic obstructive bronchitis.

Smoking and Cancer

Additional evidence substantiates the previous findings that cigarette smoking is the main cause of lung cancer in men. Cigarette smoking is causally related to lung cancer in women but accounts for a smaller proportion of cases than in men. Smoking is a significant factor in the causation of cancer of the larynx and in the development of cancer of the oral cavity. Further epidemiological data strengthen the association of cigarette smoking with cancer of the bladder and cancer of the pancreas.

The most recent Public Health Service review of the effects of smoking on pregnancy was presented in the 1967 Report. The conclusions of that review were as follows:

Clearly, more research is needed to elucidate the significance of the relationship of smoking in pregnancy and low birth weight. Additional long-range morbidity studies are needed, as well as studies on the effect of smoking on uterine activities and placental blood flow.

Smoking does have an effect on the outcome of pregnancy. However, it is not known whether this effect is deleterious or not.

Until such evidence is presented so as to clearly define the role of smoking in pregnancy, it is more prudent at this time to advise pregnant women to stop or decrease their cigarette-smoking practices.

No substantial negative evidence has appeared which refutes these judgments. On the contrary, studies made available since the publication of the 1968 Supplement and reviewed by panels of experts in the relevant medical areas confirm previous findings and add new evidence that smoking is a health hazard. Highlights of the 1969 Supplement are as follows:

I. Smoking and Cardiovascular Diseases

Further data from prospective studies confirm the judgment that cigarette smoking is a significant risk factor that contributes to the development of coronary heart disease, apparently by promoting myocardial infarct and cardiac arrhythmias. Analyses by several investigators of other associated factors (high serum cholesterol, high blood pressure and body weight) show clearly that the effect of cigarette smoking persists and is appreciable, even when these other factors are carefully evaluated. Autopsy studies suggest that cigarette smoking is associated with a significant increase in atherosclerosis of the aorta and the coronary arteries. Experimental studies in animals have pro-

vided new information on the pathological effects of cigarette smoking on the arteries. This further supports the view that cigarette smoking promotes atherosclerosis.

II. Smoking and Chronic Obstructive Bronchopulmonary Diseases

Recent studies have demonstrated that cigarette smokers may have significant disease of the small airways in the absence of bronchopulmonary symptoms. This disease is demonstrated by the finding of abnormalities in the ventilation/perfusion relationships in the lungs of cigarette smokers. Animal experiments have demonstrated the pathological effects caused in the lung by exposure to cigarette smoke or to specified concentrations of products found in cigarette smoke. Conditions similar to pulmonary emphysema in man have been produced in some of these experiments. Other studies have investigated the pathological effects of smoking on pulmonary clearance mechanisms and demonstrated that pulmonary clearance may be significantly impaired by the effects of cigarette smoking. Epidemiological and laboratory evidence supports the view that cigarette smoking can contribute to the development of pulmonary emphysema in man.

III. Smoking and Cancer

A major pathological study of histological changes in the larynx has demonstrated a dose-relationship between smoking and premalignant changes in the larnyx. New animal models for the experimental study of respiratory cancer, which may be helpful in elucidating the mechanisms of respiratory tract carcinogenesis, have been developed and refined. More studies have been done to identify those substances in tobacco smoke which take part in carcinogenesis. These studies may help to define the exact biomechanisms involved in the cause and effect relationship between cigarette smoking and lung cancer.

IV. Effect of Smoking on Pregnancy

New data are presented which confirm the finding that maternal smoking during pregnancy is associated with low birth weight in infants and also indicate that maternal smoking is associated with an increased incidence of prematurity defined by weight alone. In addition, it appears that maternal smoking during pregnancy may be associated with an increased incidence of spontaneous abortion, stillbirth, and neonatal death and that this relationship may be most marked in the presence of other risk factors.

V. Smoking and Noncancerous Oral Disease

The chapter on noncancerous oral disease is the first Public Health Service review of this subject. The data available lead to the conclusion that ulceromembranous gingivitis, alveolar bone loss, and stomatitis

nicotina are more commonly found among smokers than among nonsmokers. The influence of smoking on periodontal disease and gingivitis probably operates in conjunction with poor oral hygiene. In addition, there is evidence that smoking may be associated with edentulism and delayed socket healing.

Tobacco smoke contains a large number and a wide variety of compounds which may result in complex and multiple pathophysiological effects on the various tissues and organ systems. While further research is needed to investigate the exact biomechanisms involved in the pathological effects of smoking, the evidence clearly shows that cigarette smoking constitutes a major health hazard in the United States.

PART 2

Technical Reports on the Relationship of Smoking to Specific Disease Categories

360-928 O—69——2

CHAPTER 1

Smoking and Cardiovascular Diseases

Contents

SMOKING AND CARDIOVASCULAR DISEASES

Summary

Coronary heart disease (CHD) among men in the Western world is an epidemic which cuts short the lives of many in their prime productive years. The evidence linking smoking and CHD has been reported not only from studies in the United States, but also from such diverse areas as West Germany, the U.S.S.R., France, Israel, Italy, and the British Isles.

The 1968 Supplement (*27*) stated:

> Because of the increasing convergence of epidemiological and physiological findings relating cigarette smoking to coronary heart disease, it is concluded that cigarette smoking can contribute to the development of cardiovascular disease and particularly to death from coronary heart disease.

The convergence of autopsy data and experimental data presented in this and previous reports suggests that cigarette smoking promotes atherosclerosis, including that of the coronary arteries. The results of physiological research and the findings of diminished risk of CHD in those who have stopped smoking indicate that there is also a more immediate mechanism operative. The mechanisms which might be responsible for the promotion of myocardial infarction and fatal cardiac arrhythmias by cigarette smoking were extensively reviewed in the 1968 Supplement (*27*). Briefly stated, nutrient supply to the myocardium in general and, perhaps more importantly, to focal ischemic areas of the myocardium may be seriously compromised by a combination of effects caused by smoking, and the deprived myocardium may become infarcted or develop an arrhythmia. These effects include diminution of blood flow through atherosclerotic coronary vessels and diminution of available oxygen for tissue use resulting from the binding of carbon monoxide to hemoglobin in the place of oxygen and

possibly, although presently speculative, the poisoning of respiratory enzymes by hydrogen cyanide.

Cigarette smoking has been shown to be an important risk factor in the development of CHD. It is important both by itself and in the presence of other significant risk factors. In combination with certain other risk factors, the joint effects appear to be even greater than those accounted for by those risk factors independently.

Epidemiological Studies

Hammond, et al. (*11*) have presented new data on mortality from CHD, stroke, and nonsyphilitic aortic aneurysm among more than 800,000 men and women who were between the ages of 40 and 79 in 1959. The authors were attempting to evaluate the significance of multiple factors (sex, age, diabetes, high blood pressure, body weight, change in weight, exercise, cigarette smoking, sleep, and nervous tension) in the variations in death rates from these three diseases. It should be noted that this information consisted of self-reports obtained by questionnaire and were not obtained from medical examination. Causes of death were based on death certificate reports.

As illustrated in table 1, coronary heart disease death rates and mortality ratios increased with increased cigarette smoking for men in all age groups and for women under the age of 70. Although the mortality ratios were higher in the younger age groups, the differences in death rates between nonsmokers and heavy smokers became progressively higher with increasing age. Although CHD rates were higher for those who were 10 percent or more above the average weight for their height-age-sex group, and for those who reported having high blood pressure, the trend is clear that the effect of smoking persists and is appreciable, even when these other factors are held constant (table 2).

TABLE 1.—*Death rates and mortality ratios for coronary heart disease and stroke, by amount of cigarette smoking, sex, and age*

Sex and age	Coronary heart disease					Stroke				
	Never smoked cigarettes regularly	Regularly smoked cigarettes				Never smoked cigarettes regularly	Regularly smoked cigarettes			
		Number smoked daily					Number smoked daily			
		1–9	10–19	20–39	40 or more		1–9	10–19	20–39	40 or more
	DEATH RATES									
Males:										
40–49 years	68	109	176	256	375	14	39	[2] 16	31	23
50–59 years	257	409	548	616	718	40	78	59	81	96
60–69 years	650	961	1,184	1,241	1,166	168	219	242	272	289
70–79 years	1,730	1,970	2,431	2,573	2,548	650	617	598	792	[2] 445
Females:										
40–49 years	13	17	27	47	[2] 43	10	15	26	29	[2] 57
50–59 years	59	68	140	158	220	27	34	73	72	[2] 95
60–69 years	268	279	479	558	[2] 542	110	139	236	201	--
70–79 years	979	740	963	1,243	---	487	404	[2] 276	622	--
	MORTALITY RATIOS [1]									
Males:										
40–49 years	1.00	1.60	2.59	3.76	5.51	1.00	2.79	[2] 1.14	2.21	1.64
50–59 years	1.00	1.59	2.13	2.40	2.79	1.00	1.95	1.48	2.03	2.40
60–69 years	1.00	1.48	1.82	1.91	1.79	1.00	1.30	1.44	1.62	1.72
70–79 years	1.00	1.14	1.41	1.49	1.47	1.00	.95	.92	1.22	[2] .68
Females:										
40–49 years	1.00	1.31	2.08	3.62	[2] 3.31	1.00	1.50	2.60	2.90	[2] 5.70
50–59 years	1.00	1.15	2.37	2.68	3.73	1.00	1.26	2.70	2.67	[2] 3.52
60–69 years	1.00	1.04	1.79	2.08	[2] 2.02	1.00	1.26	2.15	1.83	----
70–79 years	1.00	.76	.98	1.27	----	1.00	.83	[2] .57	1.28	----

[1] The mortality ratio is the observed rate divided by the expected rate.

[2] Rates based upon only 5 to 9 deaths.

SOURCE: Hammond, E. C., et al. (*11*).

TABLE 2.—*Coronary heart disease death rates for men and women classified by smoking habits, age, blood pressure, and relative weight*

Extent of cigarette smoking and age	No high blood pressure, by relative weight					High blood pressure, by relative weight				
	Total	Less than 90	90–109	110–119	120 and over	Total	Less than 90	90–109	110–119	120 and over
	MEN									
None or slight:										
40–49 years	52	[1] 27	46	64	128	204	---	195	[1] 210	-----
50–59 years	226	140	216	263	390	620	[1] 686	611	643	609
60–69 years	603	542	573	701	763	1,503	1,777	1,295	1,860	1,855
70–79 years	1,611	1,467	1,555	1,840	1,868	2,738	3,342	2,588	2,651	3,100
Intermediate:										
40–49 years	116	108	104	141	245	249	[1] 354	266	[1] 286	-----
50–59 years	373	352	363	405	538	876	1,424	686	1,182	995
60–69 years	888	814	890	984	973	1,876	1,913	1,999	1,447	1,710
70–79 years	1,973	2,237	1,778	1,953	2,901	3,220	3,700	3,172	2,213	5,451
20 or more:										0
40–49 years	222	123	235	309	276	647	687	550	765	888
50–59 years	530	422	536	666	641	1,137	1,148	1,153	933	1,41
60–69 years	1,047	978	1,019	1,249	1,307	1,986	2,160	1,993	1,744	2,075
70–79 years	2,286	2,346	2,205	2,151	2,846	4,123	5,141	4,205	[1] 3,692	-----
	WOMEN									
None or slight:										
40–49 years	8	[1] 5	7	---	22	63	---	53	-----	75
50–59 years	41	39	32	64	68	161	100	142	157	229
60–69 years	201	153	191	265	323	469	400	495	462	469
70–79 years	776	832	779	667	754	1.338	1,313	1,217	1,449	1,626
Intermediate:										
40–49 years	15	17	12	---	---	86	---	[1] 76	-----	-----
50–59 years	76	69	70	153	[1] 73	281	361	281	[1] 233	[1] 198
60–69 years	284	337	244	422	---	730	732	743	848	[1] 484
70–79 years	607	736	551	---	---	1,161	[1] 1,854	1,014	-----	-----
20 or more:										
40–49 years	36	25	38	[1] 42	[1] 73	144	---	198	-----	-----
50–59 years	120	118	128	---	[1] 135	358	[1] 263	291	[1] 584	[1] 706
60–69 years	467	341	539	[1] 637	---	811	[1] 798	1,100	-----	-----
70–79 years	644	[1] 866	[1] 585	---	---	2,463	---	[1] 3,743	-----	-----

[1] Rates based upon only 5 to 9 deaths.

SOURCE: Hammond, E. C., et al. (*11*).

Hammond, et al. also studied CHD mortality among men who were ex-smokers of cigarettes. The death rates from CHD were lower among the ex-smokers than among those still smoking at the beginning of the study, the size of the difference being larger the longer they had been off smoking (table 3). Some people stop smoking because of illness or symptoms and these people would be expected to have higher death rates than those who stop for other reasons. Early deaths among those with preexisting disease may account, at least in part, for the high death rates from CHD among ex-smokers in the early years of abstention.

Mortality ratios for stroke were higher among cigarette smokers with the exception of those over 70 years of age. Male ex-cigarette smokers had mortality ratios for stroke approximately equal to those of nonsmokers.

A clear increase in mortality from nonsyphilitic aortic aneurysms with increasing cigarette smoking among men aged 50–69 is seen in table 4. The mortality ratio for heavy smokers was 8.00.

Hammond, et al. found that death rates from the three diseases varied considerably with relative weight, amount of exercise, amount of cigarette smoking, and hours of sleep per night. Subjects who were obese, took little or no exercise, smoked many cigarettes a day, or slept 9 or more hours per night had high death rates. Those with a combination of these factors have especially high death rates from the three diseases.

TABLE 3.—*Observed and expected number of deaths and mortality ratios for ex-cigarette smokers with a history of smoking only cigarettes, by number of years since last cigarette smoking and for current cigarette smokers, coronary heart disease and stroke; compared to persons who never smoked regularly, in men aged 40–79*

Type of smoker	Coronary heart disease			Stroke		
	Observed	Expected	Ratio	Observed	Expected	Ratio
Ex-cigarette smokers (former smokers of 1–19 cigarettes a day):						
Stopped:						
Less than 1 year	29	17.9	1.62	------	------	------
1–4 years	57	46.6	1.22	------	------	------
5–9 years	55	43.7	1.26	------	------	------
10–19 years	52	54.1	.96	------	------	------
20 or more years	70	64.7	1.08	------	------	------
Total	263	226.9	1.16	57	56.9	1.00
Current cigarette smokers	1,063	559.5	1.90	207	134.5	1.54
Never smoked regularly	1,841	1,841.0	1.00	501	501.0	1.00
Ex-cigarette smokers (former smokers of 20 or more cigarettes a day):						
Stopped:						
Less than 1 year	62	38.6	1.61	------	------	------
1–4 years	154	101.9	1.51	------	------	------
5–9 years	135	116.5	1.16	------	------	------
10–19 years	133	106.1	1.25	------	------	------
20 or more years	80	76.4	1.05	------	------	------
Total	564	439.7	1.28	94	101.1	0.93
Current cigarette smokers	2,822	1,104.7	2.55	440	234.7	1.87
Never smoked regularly	1,841	1,841.0	1.00	501	501.0	1.00

SOURCE: Hammond, E. C., et al. (*11*).

TABLE 4.—*Aortic aneurysm death rates and mortality ratios for men aged 50–69, classified by cigarette smoking habits*

[Rates per 1,000 population]

Measure	Never smoked regularly	Current smokers, by daily cigarette consumption			
		1–9	10–19	20–39	40 or more
Death rate	13	34	50	59	104
Mortality ratio	1.00	2.62	3.85	4.54	8.00

SOURCE: Hammond, E. C., et al. (*11*).

They also found that death rates from CHD and stroke were lower in ex-cigarette smokers than in men who were currently smoking cigarettes at the time they enrolled in the study. The death rates of male ex-cigarette smokers who had not smoked for 10 to 20 years were no higher or only slightly higher than the death rates of men who had never smoked regularly. Death rates from the three diseases were lowest among subjects without a history of diabetes or high blood pressure who were not obese, took at least moderate exercise, never smoked regularly and slept 6 to 8 hours per night. Nevertheless, even these subjects had substantial death rates from CHD, stroke and nonsyphilitic aortic aneurysm.

Stamler (*24*) has anaylzed 10-year mortality data on a total cohort of men, aged 40–59 in 1958, who were employees of the Chicago Peoples Gas Light and Coke Co. Of 1,465 men examined, 1,325 were found initially to be free of definite CHD and have been followed without systematic intervention. Higher overall death rates were found among the smokers in the study. Table 5 shows the death rates from CHD and from all causes for men with various risk factors.

Recent papers by Thorne, et al. (*25*) and by Paffenbarger, et al. (*19*) report further results of studies of CHD among former college students. College health records and other college records were reviewed to ascertain the presence or absence of factors under consideration. Cases were identified from death certificates in the study of fatal CHD (*19*) and from questionnaires and physical examinations in the study of nonfatal CHD (*25*). Matched controls were obtained for each case. In both nonfatal and fatal CHD, significantly more smokers were found among the cases than among the controls. Combinations of risk factors resulted in greater CHD morbidity and mortality ratios than did single factors. Figure 1 shows the morbidity ratios for combinations of pairs of risk factors in nonfatal CHD and table 6 shows mortality ratios for combinations of risk factors in fatal CHD.

TABLE 5.—*10-year mortality rates for sudden death, coronary heart disease, stroke, cardiovascular-renal, and all causes combined among men aged 40–59, classified according to cigarette smoking, cholesterol, and blood pressure*

[Peoples Gas Light Co. Study, 1958–68. Men originally free of coronary heart disease and followed without systematic intervention.]

1958 risk factor status—cigarette smoking (10 or more a day), hypercholesterolemia, hypertension [1]	10-year mortality										
	Sudden death			All CHD		Stroke		All CVR		All causes	
	Number of mean in cohort	Number of deaths	Death rate [2]	Number of deaths	Death rate	Number of deaths	Death rate	Number of deaths	Death rate	Number of deaths	Death rate
No risk factor	284	0	0	1	3.0	2	5.9	4	11.9	13	42.6
Hypercholesterolemia or hypertension only—1 factor	216	4	19.6	13	53.1	6	19.5	19	72.6	27	101.5
Cigarette smoking only (10 or more a day)—1 factor	405	4	10.0	15	37.1	5	11.8	20	48.9	44	107.7
Hypercholesterolemia and hypertension only—2 factors	60	1	9.9	3	29.6	1	40.7	4	70.3	8	121.9
Cigarette smoking (10 or more a day) and hypercholesterolemia or cigarette smoking and hypertension—2 factors	293	11	37.2	17	57.1	6	19.9	26	86.4	53	169.9
Cigarette smoking (10 or more a day), hypercholesterolemia, hypertension—all 3	67	2	25.1	6	76.0	2	25.4	8	101.5	17	225.8
Total	[3] 1,325	22	16.2	55	39.2	22	14.9	81	56.6	162	113.1

[1] Risk factors include: Serum cholesterol 250 or more mg./dl.; diastolic blood pressure 90 or more mm. Hg; 10 or more cigarettes/day.

[2] All rates are age-adjusted by 5-year age groups to the U.S. male population, 1960. All rates per thousand.

[3] Smoking data were not obtained for 4 of the 1,329 men.

SOURCE: Stamler, J. (*24*).

TABLE 6.—*Estimated coronary heart disease death ratios in a 17–51 year followup among former college students, classified according to combined presence (+) or absence (—) of each of three specified risk factors, and by age*

Risk factor			Age (years) at death from coronary heart disease			
Cigarettes, 10 or more/day	Systolic BP, 130 or more mm. Hg	Ponderal index, less than 12.9	Total 30–69 years	30–44 years	45–54 years	55–69 years
+	+	+	4.3	[1] (1.9)	5.7	[1] (4.8)
+	—	+	1.8	2.3	1.6	[1] (2.0)
+	+	—	4.2	2.9	4.5	5.6
—	+	+	1.9	2.9	1.6	1.8
+	—	—	1.7	2.2	1.9	1.3
—	+	—	1.3	1.2	1.2	1.4
—	—	+	1.1	1.4	1.4	.8
—	—	—	1.0	1.0	1.0	1.0

[1] Numbers in parentheses indicate expected number coronary heart disease decedents less than 5.
SOURCE: Paffenbarger, R. S., et al. (*19*).

In a study of participants in the Health Insurance Plan of New York, Weinblatt, et al. (*29*) reported that cigarette smoking males who developed angina pectoris were more likely to develop infarction than were nonsmoking anginal patients, but there were not enough cases to draw definite conclusions.

Weinblatt, et al. (*30*) also reported that the prognosis after the development of a myocardial infarction appears to be independent of smoking status prior to the infarct. In the absence of data indicating which patients stop smoking and how stopping smoking is related to the severity of myocardial damage, one cannot evaluate the effect of smoking on prognosis. If the persons who stop smoking tend to include the most debilitated, the effect of continued smoking on prognosis would be underestimated.

In a prospective study of over 3,000 men, Jenkins, et al. (*14*) reported that the incidence of CHD in men aged 39–49 was three times higher among the cigarette smokers than among the nonsmokers (table 7). The incidence of CHD increased with increased daily cigarette consumption. For men aged 50–59, the relationship between cigarette smoking and CHD was found to be significant only for the heavy

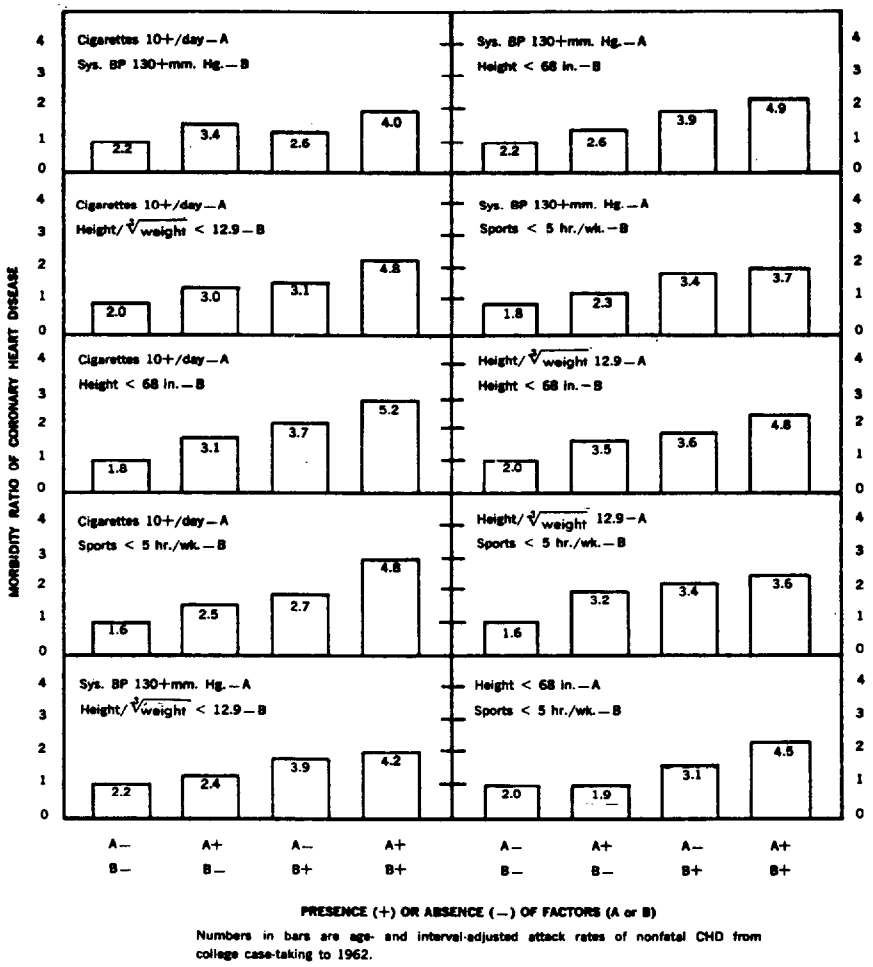

FIGURE 1.—Morbidity ratios of coronary heart disease for paired combinations of factors in college.

SOURCE: Thorne, M.C., et al. (*25*).

smokers (table 8). Former cigarette smokers also had significantly higher CHD incidence rates, but no data are given on length of time since stopping smoking, or reasons for stopping. Pipe and cigar smokers did not have higher CHD incidence rates. After controlling for other risk factors such as lipid levels, diastolic blood pressure, and body build, the authors found that the association between cigarette smoking and CHD remained (tables 9, 10). The relationship between smoking and CHD was stronger among those men who exhibited behavior type A than those exhibiting behavior type B (tables 11, 12). Behavior type A is characterized by enhanced competitiveness, drive, aggressiveness, hostility, and an excessive sense of time urgency. Behavior type B indicates an absence of these characteristics. Analysis of the data on behavior and cigarette smoking showed that both factors have effects on the CHD rate. Again, these associations were stronger in the younger age group.

TABLE 7.—*Annual incidence rates of coronary heart disease for men 39–49 years of age, classified by smoking history and by current practices as to cigarette smoking*

[Age as of the beginning of the 4½ year period of observation]

Morbidity status	Total subjects		Smoking history								Current cigarette smoking by number per day							
			Never smoked		Pipe and cigar only		Former cigarette		Current cigarette		None		1–15		16–25		26 or more	
	Number	Rate [1]	Number	Rate	Number	Rate	Number	Rate	Number	Rate	Number	Rate	Number	Rate	Number	Rate	Number	Rate
Total number at risk	2,258	-----	540	-----	405	-----	239	-----	1,074	-----	1,191	-----	211	-----	434	-----	422	-----
Total number CHD cases	63	6.2	7	[2] 2.9	3	1.6	10	[3] 9.3	43	[3] 8.9	20	[3] 3.7	5	5.3	18	[4] 9.2	20	[4] 10.5
All myocardial infarction	52	5.1	4	1.7	3	1.6	10	9.3	35	7.2	17	3.1	4	4.2	13	6.7	18	9.5
Symptomatic	38	3.7	1	.4	2	1.1	8	7.4	27	5.6	11	2.0	4	4.2	11	5.6	12	6.3
Unrecognized	14	1.4	3	1.2	1	.5	2	1.9	8	1.7	6	1.1	0	0	2	1.0	6	3.1
Fatal	9	.9	0	0	0	0	1	.9	8	1.7	1	.2	0	0	5	2.6	3	1.6
Angina pectoris only	11	1.1	3	1.2	0	0	0	0	8	1.7	3	.6	1	1.0	5	2.6	2	1.1

[1] Annual rate per 1,000 men at risk.

[2] These distributions of cases for various smoking categories are significantly different from chance at P=0.001.

[3] Difference in CHD frequency between this group and those who never smoked cigarettes (col. 1 and 2 combined) is significant at P=0.01 by chi square test corrected for continuity.

[4] Difference in CHD frequency between this group and current noncigarette smokers is significant at P=0.01.

SOURCE: Jenkin, C. D., et al. (*14*).

TABLE 8.—*Annual incidence rates of coronary heart disease for men 50–59 years of age, classified by smoking history and by current practices as to cigarette smoking*

[Age as of the beginning of the 4½ year period of observation]

Morbidity status	Total subjects		Smoking history								Current cigarette smoking by number per day							
			Never smoked		Pipe and cigar only		Former cigarette		Current cigarette		None		1–15		16–25		26 or more	
	Number	Rate [1]	Number	Rate	Number	Rate	Number	Rate	Number	Rate	Number	Rate	Number	Rate	Number	Rate	Number	Rate
Total number at risk	924	-----	182	-----	161	-----	137	-----	444	-----	483	-----	109	-----	167	-----	165	-----
Total number CHD cases	70	16.8	9	[2] 11.0	11	15.2	9	14.6	41	20.5	29	[2] 13.3	6	12.2	16	21.3	[3] 19	25.6
All myocardial infarction	52	12.5	6	7.3	8	11.0	5	8.1	33	16.5	19	8.7	5	10.2	15	20.0	13	17.5
Symptomatic	35	8.4	4	4.9	4	5.5	4	6.5	23	11.5	12	5.5	4	8.2	11	14.6	8	10.8
Unrecognized	17	4.1	2	2.4	4	5.5	1	1.6	10	5.0	7	3.2	1	2.0	4	5.3	5	6.7
Fatal	14	3.4	0	0	3	4.1	3	4.9	8	4.0	6	2.8	2	4.1	4	5.3	2	2.7
Angina pectoris only	18	4.3	3	3.7	3	4.1	4	6.5	8	4.0	10	4.6	1	2.0	1	1.3	6	8.1

[1] Annual rate per 1,000 men at risk.

[2] These distributions of cases for various smoking categories could occur 0.10 of the time by chance, hence are not significant at P=0.05.

[3] Difference in CHD frequency between this group and current noncigarette smokers is significant at P=0.01.

SOURCE: Jenkins, C. D., et al. (*14*).

TABLE 9.—*Annual incidence rates of new coronary heart disease, by smoking habits, adjusted for age and seriatim, for specified other risk factors*

[Rates are annual incidence per 1,000 men, aged 39 to 49 years at entry into study]

Specified other risk factors	Never smoked	Former cigarette smokers	Pipe and cigar only	Daily cigarette consumption			p.[1]
				1-15	16-25	26 or more	
Cholesterol	33	93	22	49	89	100	0.005
Beta/alpha ratio	31	91	18	49	91	102	.001
Lipalbumin	31	95	18	51	89	102	.002
Systolic BP	31	91	18	49	95	100	.001
Diastolic BP	29	89	16	49	95	104	.001
Ponderal index	29	91	16	49	95	107	.001
Physical activity	29	93	18	47	93	104	.001
Amount of exercise	29	91	18	49	93	104	.001
Income level	29	91	18	49	93	104	.001
All of the above	36	93	20	51	89	98	.007
Triglycerides	31	88	20	40	80	104	.002

[1] Level of significance of F-ratio for analysis of covariance.

SOURCE: Jenkins, C. D., et al. (*14*).

TABLE 10.—*Annual incidence rates of new coronary heart disease, by smoking habits, adjusted for age and seriatim, for specified other risk factors*

[Rates are annual incidence per 1,000 men, aged 50 to 59 years at entry into study]

Specified other risk factors	Never smoked	Former cigarette smokers	Pipe and cigar only	Daily cigarette consumption			p.[1]
				1-15	16-25	26 or more	
Cholesterol	115	142	153	115	211	264	0.154
Beta/alpha ratio	107	142	144	120	213	262	.127
Lipalbumin	109	140	151	122	218	262	.135
Systolic BP	118	127	144	129	211	266	.136
Diastolic BP	109	127	135	127	220	273	.066
Ponderal index	107	131	140	122	222	269	.084
Physical activity	113	142	149	115	213	249	.216
Amount of exercise	113	144	151	118	211	255	.203
Income level	113	138	147	120	220	258	.156
All of the above	113	118	138	140	213	258	.158
Triglycerides	113	147	144	80	195	260	.121

[1] Level of significance of F-ratio for analysis of covariance.

SOURCE: Jenkins, C. D., et al. (*14*).

360-928 O—69——3

TABLE 11.—*Incidence of new coronary heart disease, by smoking category and behavior type, for men aged 39–49*

[Rates are age-adjusted annual incidence per 1,000 men]

Behavior type	Never smoked		Former cigarette smokers		Current and former pipe and cigar only		Daily cigarette consumption						Total	
							1–15		16–25		26 or more			
	Rates	Cases	Rates	Cases	Rates	Cases	Rates	Cases	Rates	Cases	Rates	Cases	Rates	Cases
A	5.3	5	13.8	7	1.3	1	1.6	1	15.8	15	14.9	16	9.3	45
B	1.3	2	5.1	3	2.2	2	7.3	4	3.1	3	4.9	4	3.3	18
Total	2.9	7	9.1	10	1.8	3	4.9	5	9.3	18	10.4	20	6.2	63

SOURCE: Jenkins, C. D., et al. (*14*).

TABLE 12.—*Incidence of new coronary heart disease, by smoking category and behavior type, for men aged 50–59*

[Rates are age-adjusted annual incidence per 1,000 men]

Behavior type	Never smoked		Former cigarette smokers		Current and former pipe and cigar only		Daily cigarette consumption						Total	
							1–15		16–25		26 or more			
	Rates	Cases	Rates	Cases	Rates	Cases	Rates	Cases	Rates	Cases	Rates	Cases	Rates	Cases
A	12.4	5	18.6	8	21.8	8	16.4	5	21.5	9	30.0	14	20.4	49
B	10.0	4	5.1	1	8.4	3	4.7	1	21.1	7	19.1	5	12.0	21
Total	11.1	9	14.2	9	14.9	11	11.5	6	21.3	16	26.0	19	16.8	70

SOURCE: Jenkins, C. D., et al. (*14*).

Epidemiological studies linking smoking and CHD have been carried out in various countries. In a retrospective study in Dublin, of 400 patients under the age of 65 who experienced myocardial infarction, Mulcahy, et al. (*18*) observed a definite association between smoking and the development of the disease.

A prospective epidemiological study of risk factors of CHD, in an Israeli population, indicates that smoking is associated with a higher risk of CHD (*17*).

In a retrospective study of 503 male patients with myocardial infarction and 714 age-matched controls in Munich, Schimmler, et al. (*22*) report that cigarette smoking plays a significant role as a risk factor.

A recent paper by Cederlof, et al. (*5*) employs the twin-study method on a population of American twins, using a similar approach to that previously employed in a Swedish twin population. The purpose is to compare the contribution of genetic and environmental influences to the development of angina pectoris. The authors imply that their study indicates a more important role for genetic factors than for smoking. However, this study can be criticized on several grounds. The authors based their detection of angina pectoris on the results of a self-administered questionnaire designed to elicit a history of chest pain of presumable cardiac origin; previous studies in Swedish twins have shown a low rate of clinical confirmation of heart disease in those classified positive by questionnaire. No data are available on the health and smoking habits of 58 percent of the original group or the 41 percent of the "eligible twin pairs" who were nonrespondents. The authors' definition of a present smoker includes persons who have stopped smoking cigarettes for up to 3 years and thus includes persons who in other studies have been classified as ex-smokers. This definition of a cigarette smoker might contribute to an underestimation of the immediate effect of current cigarette smoking, since an unstated number of recent ex-smokers are included in the same category as current cigarette smokers.

The relationship between cigarette smoking and the development of angina pectoris has not been clarified. However, Aronow, et al. (*1*) have shown that smoking one cigarette before exercising reduces the energy expenditure required for patients with classical angina pectoris to develop chest pain while exercising on a bicycle ergometer.

Atherosclerosis

A review of autopsy studies by Strong and Auerbach, suggesting that cigarette smoking has a chronic effect leading to advanced degrees of atherogenesis, was presented in the Health Consequences of Smoking, 1967 (*26*). Further studies have recently been published in this area.